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Some Injurious Insects of the Apple

University of Tennessee Agricultural Experiment Station

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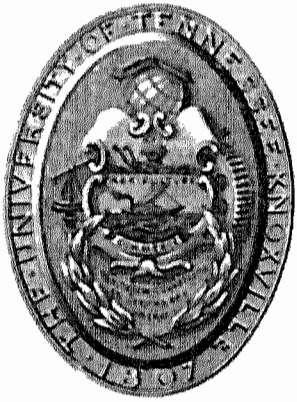
Agricultural Experiment Station

BULLETIN



VOL. VI. JANUARY, 1893. NO. 1.

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KNOXVILLE, TENNESSEE, U. S. A.

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DIVISION OF HORTICULTURE.

SOME INJURIOUS INSECTS OF THE APPLE.

BY C. E. CHAMBLISS.

In order to make farming profitable, one must know the enemies that injure his crops. The first of these are the noxious insects, and the second the parasitic fungi. The annual loss of produce, often amounting to millions of dollars, can largely be saved by possessing a knowledge of these enemies, and the methods of prevention or the remedies employed to check their ravages.

It is the purpose of this paper to give, in concise form, the life-histories of some of the injurious insects of the Apple, and also the best methods of treating or preventing their attacks upon the roots, trunk, leaves and fruit.

As an introduction, a brief description of the various stages through which an insect passes, before reaching the imago or adult state, is given.

During the growth of an insect, it exists in four distinct stages, viz., the *egg*, the *larva*, the *pupa*, and the *imago* or adult stage.

Egg.—The eggs are of various sizes, shapes and colors. They are laid singly or in masses, being glued to whatever they may be laid upon by a gummy secretion, or raised on stalks as are the eggs of the Lace-winged Flies. There are insects, however, that insert their eggs into the bodies of living animals and plants, by means of an egg-laying apparatus known as an *ovipositor*. They pierce the bodies of living animals, causing very irritating sores, and the tissues of plants, producing galls, into which wounds they deposit their eggs. Such insects are known as parasites.

The instinctive nature of the mother insect is shown by the care she takes of the eggs. They are always placed on or near the food upon which the young larva is to feed. Shortly after the egg has been laid, the insect begins life in the form of a caterpillar, grub, or maggot, called the larva.

Larva.—It is during this stage of growth that the insect eats

voraciously and becomes so destructive to vegetation. Most insects pass through this stage in a few weeks, but some, as the "wire-worm," live for two or three years in this condition.

The larvæ of Butterflies and Moths are called *caterpillars*. They are the prettiest and probably the most voracious of all larvæ. They possess six thoracic legs, and from four to ten fleshy prop-legs or sucking feet, which enable them to hold firmly to the twigs.

The larvæ of Beetles are called *grubs*. They are generally provided with six thoracic legs, and sometimes, in addition, a terminal prop-leg.

The larvæ of Flies are called *maggots*. They are without legs, and more worm-like than any other larvæ.

Pupa.—During the *pupal* or *chrysalis* stage, the insect lies inactive within a hard protecting case, which may be found either below the ground, or in some protected place beneath stones, boards, or in crevices of bark. This period of its life varies from a few weeks to months, during which time marvelous changes are made in bodily form and structure, which result in a perfect insect, that has no resemblance to the crawling and voracious worm which, only a few weeks or months previous, was defoliating trees or injuring crops.

Imago.—The insect has now reached its perfect condition. Its future career is short—life varying in duration from a few hours or days to weeks; but in some instances, where the insect hibernates in the adult state, it lives for months. For the first time in its life-history, it possesses fully developed reproductive organs, and to perform its only mission, that of propagating its kind, it soon pairs. After pairing, the male dies, leaving to the care of the female the perpetuation of the species. The female also dies in a short time after the eggs have been deposited.

The phenomena exhibited by the growth of the insect from the larval to perfect condition, may be divided into three groups.

Of the first group, we have insects that have *no* metamorphosis; the adult insect differs from the larva only in size, for it never possesses wings; e. g., Spring-tails, Fish-moths, etc.

Of the second group, we have insects that have an *incomplete* metamorphosis, the form of the adult insect being apparent through all the stages; e. g., the Grasshoppers, and "Bugs." The larva increases in size by numerous moults, and passes into the pupal stage with the addition of rudimentary wings, yet preserving the form of an adult insect.

Of the third group, we have insects that have a *complete* metamorphosis, in which the immature insect bears no resemblance in form to the adult; e. g., the Butterflies, Moths and Beetles.

Besides a knowledge of the changes or metamorphoses, the farmer should understand the structural characters of insect enemies so as to be enabled to apply intelligently insecticides, and other preventives against their depredations.

As to the manner in which insects feed, they may be divided into two great groups, namely, biting and sucking insects.

The biting insects have jaws or mandibles, that move laterally, enabling them to tear and chew foliage, hard wood, and fruit. As insects that take their food in the solid form, may be mentioned the beetles, grasshoppers, and many of the voracious larvæ.

The sucking insects take their food in the liquid state, and have their mouth parts formed into a long, hard and pointed beak, with which they puncture the tissues of the plant and draw their liquid nourishment. The plant-lice and "true bugs" may be mentioned as typical examples of sucking insects.

Knowing how insects take their food, we can attack them with the proper insecticides or substances that will destroy them. For biting insects, we can use poisons, such as Paris green or London purple, that will be eaten along with the ordinary food. These chemical substances can be applied either wet or dry, but care should be taken not to use so strong a preparation as to injure the foliage. When applied dry, they should be well mixed with some fine powder, as plaster, air-slacked lime or finely-sifted wood ashes. When applied wet, use one pound of poison to 250 gallons of water, and stir constantly as to keep it in suspension, for these mineral poisons are not very soluble.

As the sucking insects pierce the plants to obtain nourishment, we must use such substances that will kill by contact, that is, by closing the breathing pores or cause death by irritation. Kerosene emulsion is commonly used for this purpose.

Kerosene Emulsion.—Boil one-half pound of common hard soap in one gallon of water until fully dissolved; then add this soap solution, boiling hot, to two gallons of kerosene, and agitate violently until they combine into a creamy liquid. To prepare for use, dilute with fifteen parts of water.

We may often prevent the attacks of insects by using substances having offensive odors, or contrivances which will serve as mechanical barriers.

INSECTS ATTACKING THE ROOTS.

The Apple-root Louse, or Woolly-louse of the Apple.

SCHIZONEURA LANIGERA *Hausm.*

Order, *Hemiptera-Homoptera.* Family, *Aphididæ.*

DESCRIPTION.—From the minute eggs that are laid in the crevices of the bark, at or near the surface of the ground, are hatched the young lice, which are so completely covered with white down as to appear like mould. As the insect grows, this covering becomes more distinct, apparently issuing from pores of the skin of the abdomen. When the female has reached full development, it measures about one-tenth of an inch in length. It is oval in shape, with black head and and feet, but with dusty legs and antennæ. The abdomen is yellowish, but covered with a white mealy powder.

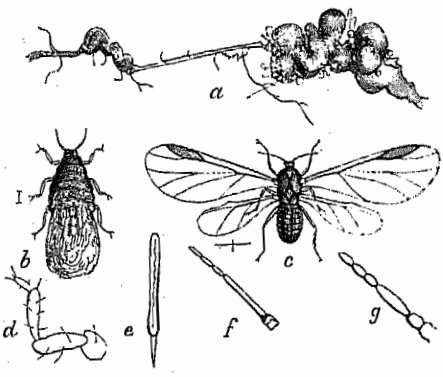

Fig. 1. SCHIZONEURA LANIGERA *Hausm.* The Apple-root Louse, or Woolly-louse of the Apple.—*a*, an infested root; *b*, larva; *c*, winged adult; *d*, leg of adult, enlarged; *e*, beak of adult, enlarged; *f*, antennæ of adult, enlarged; *g*, antennæ of larva, enlarged.

Life-history.—There are two forms of this insect recognized, and by some entomologists they are considered as distinct species, though they are only the same species living under different conditions.

One form is known as the Apple-root Louse, which produces wart-like excrescences or swellings on the roots, and the other form, the Woolly-louse of the Apple, which covers the underside of the trunks and branches with a white powder. As to which is the original form and which the variety, entomologists have not agreed.

There are also different opinions as to its nativity. Some claim that it is a native of America, but more accredit it to Europe, where it is so destructive and common.

The Woolly-louse Form--This form attach themselves to the branches and trunk, where by means of their long beaks they draw heavily upon the vitality of the tree, and when in large numbers may kill it. Under each patch of down may be found the female and her

young. During the summer the females are wingless, but on the approach of autumn the broods contain both winged males and females, and it is by this winged form that the pests spread so rapidly through the orchard.

The young are produced alive by the female, and the most alarming feature about this enemy is the wonderful rapidity with which the young are produced.

In spring and summer, this form cluster about the base of the trunk, but in autumn they commonly take to the axils of the leaves.

Work.—They feed upon the sap of the trunk and branches, and, when in large numbers, they may kill the tree. Wherever colonies are located, the branch or trunk has a mouldy appearance.

Natural Enemies.—The louse is preyed upon by "lady-birds" and their larvæ, the larvæ of lace-wing flies and syrphus flies, and also by a small chalcid fly (Aphalinus mali *Hold.*). Spiders also feed upon them; they spin their webs over the colonies and devour them at their leisure. There is no record of birds feeding upon them.

Remedies.—One may rid an infested tree of this pest by washing the trunk and large limbs with a strong solution of soap applied with a sponge. Use great care to destroy all eggs, and treat the ground with carbon bisulphide. It will do no harm to place in the forks of the trees pieces of hard soap, which will be dissolved and washed down by rains, thus preventing the louse from getting a foothold.

Root-louse Form.—It is this form that puncture the roots and rootlets of the tree, by their fine sharp pointed sucking beaks. They draw from the root its nourishing juices and produce swellings, which are the expansions of the root tissues, caused by the irritation of the puncture.

Work.—Should the tree appear sickly and the leaves become yellow, it will pay to examine the roots, if there is no visible enemy nor indication of any at work. Upon a close examination of the roots may be found small swellings of various shapes, enclosing minute insects with a covering of bluish-white "wool."

Natural Enemies.—Numbers of the root form are destroyed by several predaceous beetles, and footless maggots of various flies, principally syrphids. To have healthy trees, one cannot rely entirely upon this source for their destruction, but must resort to artificial methods.

Remedies.—The most effective treatment for the infested roots is to pour upon them scalding water, at a temperature not exceeding 150 deg. Fah. For this treatment the roots can be laid bare without doing them harm.

The roots may also be treated with soap-suds, after which may follow a liberal dressing of wood ashes. Young trees from the nursery, when found to be infested, should have their roots dipped into weak lye.

OTHER INSECTS ATTACKING THE ROOTS.

The Broad-necked Prionus, PRIONUS LATICOLLIS *Drury;* The Tile-horned Prionus, PRIONUS IMBRICORNIS *Linn;* Periodical Cicadas, or Seventeen and Thirteen-year Locusts, CICADA SEPTEMDECIM *Linn;* and CICADA TREDECIM *Riley*, and LUCANUS DAMA *Thunb.*

INSECTS ATTACKING THE TRUNK.

The Round-headed Apple-tree Borer.

SAPERDA CANDIDA *Fabr.*

Order, *Coleoptera;* Family, *Cerambycidæ.*

DESCRIPTION.—*Larva.*—From the egg hatches a minute, footless grub of a whitish color, but with a yellowish head. The head of the full grown larva is "small, horny and brown; the first ring or segment is much larger than the others; the next two are very short, as are also the eleventh and twelfth; the rings from the fourth to the tenth inclusive, are each furnished on the upper side with two fleshy warts, which are situated close together and are destitute of rasp-like teeth, which are usually found on the grubs of the other kinds of borers; no appearance of legs can be seen even with a magnifying glass of high power." When full grown, it measures about one inch in length, and the color becomes more of a yellow.

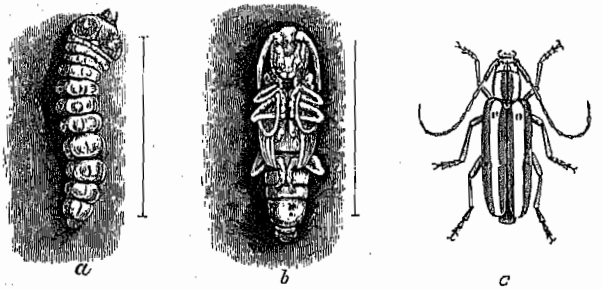

Fig. 2. SAPERDA CANDIDA *Fabr.* Round-headed Apple-tree Borer. —*a*, larva; *b*, pupa; *c*, imago.

Imago.—The beetle is of a cinnamon-brown color, marked by two white stripes, extending from the head to the tips of the wing cases. The face, antennæ and legs are white. The antennæ are nearly as long as the insect, which measures about an inch in length.

Life-history.—The larva of this borer pursues its destructive work concealed in the hard wood of the trunk of the tree. Soon after the leaves put forth, the perfect insect makes its appearance. In a few days after pairing, the female deposits eggs in the crev-

ices of the bark, usually near the surface of the ground, but sometimes where the branches start out from the trunk.

Two weeks pass after the deposition of the eggs before the larvæ appear. They are quite small, and immediately after they are hatched, they eat their way obliquely downward through the bark, and for the first year of their existence they live upon the inner bark of the sap wood. Their presence may be detected by an experienced eye by an orange-colored mass of excrement, which they push through the opening of their burrow.

During the second year of their lives, they enlarge their burrows, and the pellets, which are thrown out, have the shape of oat grains, but larger. Commonly these pellets are found in pairs, lying parallel with their points towards the tree.

It is during the last summer and autumn of their lives that they do so much damage. They eat voraciously until quite cold weather, and then keep quiet until spring, when they cut through the trunk to just under the bark, leaving only the thickness of writing paper between them and the exterior. After drawing back about an inch, the larva places chips before and behind itself, and there changes to the pupa form, remaining thus from two to six weeks before emerging as a perfect insect.

Work.—In destructiveness to the apple tree, the Round-headed Borer ranks next to the Codlin Moth. Their entrance into the tree produces a discoloration in the bark, which can be readily detected upon a close examination during the first fall of their existence. The last year of their larval condition is most disastrous to the tree. They widen their burrows, and destroy the alburnum deposited the year before, and often the layer under it. One borer can completely destroy a tree which has only a diameter of an inch and a half. A large tree is more liable to an attack, and although one borer cannot kill it, the chances are that there are many inhabiting it, and thus it too must succumb, for they girdle it to within one-fourth of an inch of each other's burrows.

Other Food-plants.—The grub of this beetle also bores into the trunk of pear, quince and similar trees.

Remedies.—Knowing that the female deposits the eggs upon the bark of the tree, we should first use such a remedy that will repulse her, and thus prevent the injury. The following mixture may be applied, not later than 15th of May.

Mix one quart of soft soap, or about a pound of hard soap, with two gallons of water, heated to boiling, and then add a pint of crude carbolic acid. If the bark of the trunk is especially rough, scrape well and then apply the solution with a scrub brush, which will excellently serve for the purpose. As a further precaution,

one may examine the trees, during late summer and early autumn, for eggs and grubs, which can easily be destroyed with a knife. The latter remedy is quite a slow process, but very effectual.

The Flat-headed Apple-tree Borer.

CHRYSOBOTHRIS FEMORATA (*Fabr.*)

Order, *Coleoptera;* Family, *Buprestidæ.*

DESCRIPTION.—*Larva.*—The grub is of a pale yellowish color and footless, having the fore part of the body greatly widened and flattened. It is by the broad and much-flattened second segment that this grub is so readily distinguished from that of the round-headed borer.

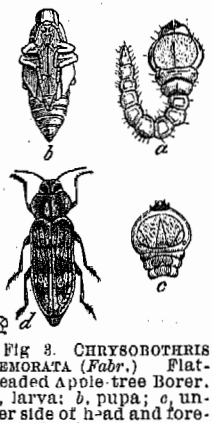

Fig 3. CHRYSOBOTHRIS FEMORATA (*Fabr.*) Flat-headed Apple-tree Borer. *a*, larva; *b*, pupa; *c*, under side of head and fore-part of body; *d*, imago.

Imago.—The perfect insect is a "greenish-black or bronze-colored beetle with metallic reflections, and the under side more coppery or brassy. The more characteristic features are two irregular, impressed transverse marks across each wing cover, dividing them into about three equal lengths."

Life-history.—The eggs from which the flat-headed borers are hatched, are placed separately, though sometimes together, beneath the bark scales, or in the crevices of the bark. They are ovoid in shape, irregularly ribbed, and pale yellow in color.

As soon as the larvæ are hatched, they enter the bark and bore their way to the green cambium layer, upon which they feed until their jaws become more developed, when they bore into the solid wood. They work their way upward, but when about to pupate, invariably cut a passage to the outside, leaving only a thin covering of bark over the hole, through which the adult insect can easily gnaw its way.

After it has made a passage back to the bark, the excrement is so packed as to make a smooth cavity, in which it remains for three weeks, at the end of which time it emerges as a bright-colored beetle.

The beetle, which appears early in May, is supposed to pass through its various stages in one year, but this has not been definitely determined. The larvæ, however, are found to vary in size in late summer, and young ones have been found in winter.

Work.—The boring of the larvæ into the trunk causes a discoloration in the affected part, which, with the sawdust-like excrement, makes their presence easily detected. Sickly and newly-planted trees are especially liable to attack.

Other Food-plants.—Besides the apple, it feeds upon the mountain ash, linden, box-elder, beech, oak, pear, cherry and peach.

Natural Enemies.—Concealment in the wood does not protect it entirely from its enemies. The larvæ are often devoured by small dirty-whitish "worms" about one-tenth of an inch long, which are known to be the larvæ of a parasitic chalcid. Besides this one, there are two species of ichneumonidæ, which aid in reducing the number of the borers. One of the species, Labena grallator *Cress.*, may be recognized by its honey-yellow body and hyaline wings, clouded with broad, smoky-brown patches; expanse of wings, nearly an inch. We are also indebted to the woodpecker for destroying a large number of them.

Remedies.—The same remedies used for the Round-headed Apple-tree Borer can be applied for the injuries of this insect.

OTHER INSECTS ATTACKING THE TRUNK.

The Fruit-bark Beetle, SCOLYTUS RUGULOSUS *Ratz.*, and the Prickly-bark Beetle, LEPTOSTYLUS ACULIFERUS *Say.*

INSECTS INJURING THE LEAVES.

The Apple Bucculatrix.

BUCCULATRIX POMIFOLIELLA *Clemens.*

Order, *Lepidoptera;* Family, *Lyonetiidæ.*

DESCRIPTION.—*Larva.*—The larva is the small, dark, yellowish-green caterpillar with sixteen legs, which spins against the bark of the twigs an elongated and ribbed cocoon, about the length of a grain of rice.

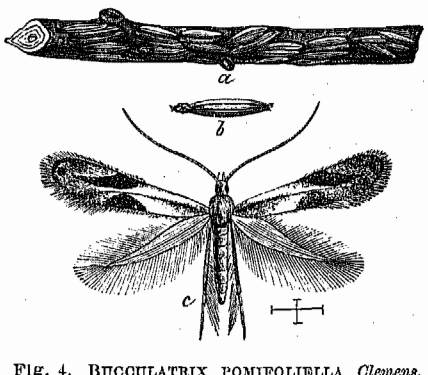

Fig. 4. BUCCULATRIX POMIFOLIELLA *Clemens.* The Apple Bucculatrix.—*a*, cocoons on a twig; *b*, one of the cocoons, enlarged; *c*, imago. Hair-lines indicate natural size.

Imago.—The perfect insect appears in early spring as a dirty white or gray-colored moth, marked with brown. There is a large dark brown oval patch on the inner margin of each fore-wing, which when the wings are closed forms a conspicuous, nearly round dorsal patch. On each fore-wing there is also a dark brown streak extending from the costa opposite the oval patch to the inner angle of the wing.

Life-history.—The larvæ and moths are so minute that they often escape observation, but the small, white, longitudinally ribbed cocoons are easily seen during the autumn and winter months on the under side of the affected twigs.

The cocoons, which measure one-fourth to five-sixteenths of an inch in length and about one-eighth in width, are cylindrical in outline, but tapering slightly towards the ends. A delicate web continues over the proper end of the cocoon, giving it the appearance of ending sharply, which is not the case. It is within this cocoon that the pupa passes the winter months, and as the leaves begin to expand in early spring it works its way partly out of the cocoon, and changes to the adult insect.

After the moth leaves the cocoon, it pairs and soon lays its eggs. Owing to their color, which is identical with that of the leaf, and their minuteness, being only one-hundredth of an inch in length, the eggs are never seen unless closely searched for. About the middle of May, these eggs, which are placed scatteringly on the under surface of the leaves, begin to produce worms, which bore directly to the upper surface of the leaf, where they form a small brown serpentine mine. In from four to five days, the larva makes a mine from one-half to three-fourths of an inch long, when it then proceeds to make its way through to the upper surface of the leaf, where it makes a silken covering, in which it is to undergo its moult.

When it has completed this covering, it gnaws a small hole near its edge, and putting its head into this, draws its body after, and when completely housed, closes the opening.

These coverings are made in from fifteen to thirty minutes, and the moulting period occupies less than twenty-four hours. After leaving the mine and before making the covering, the larva does not eat, but wanders over the leaves, stems, and branches, and may often be found suspended by silken threads.

After the first moult, it feeds externally upon the leaves, lying stretched out at full length, eating the upper epidermis and parenchyma in small patches, but not touching the lower epidermis. In three days or less, it moults again, which occupies two days, and on the third moult, it transforms to a pupa.

The larval state lasts three weeks, and when the larvæ are full grown, they desert the leaves for the twigs, on the under side of which they spin their cocoons. The spring brood remains only a week in the pupal state, the moths emerging about the first of July; and it seems that there is sufficient time for the development of a second brood before frost, as the larval and pupal states of the first brood only require a month. Such has not been ascertained, yet we call it two-brooded.

Work.—The young larva mines the leaf with an opening one-twenty-fifth of an inch broad at the largest end, and when the mines are numerous, and often there are fifteen or more on a leaf, they cause the leaves to turn yellow and die. The grown larvæ eat the upper epidermis, but not the lower, which turns brown.

Natural Enemies.—During the earlier stages of the moth's growth, it is preyed upon by parasitic ichneumons of exceeding minuteness. These little flies are of great value to the farmer, and he should never do anything to prevent their increase.

Remedies.—As the cocoons are so prominently exposed on the lower surface of the twigs during the winter, their number can be greatly reduced by thorough pruning and burning of infested twigs. The pupæ are killed by oil, and if kerosene be applied in a fine spray, and in small amounts, it will destroy them, and as oil evaporates in a few hours, no injury will be done to the dormant wood.

From the fact that during the greater part of their larval existence they feed upon the leaves, we are able to wage war upon them by spraying with Paris green water during the early part of June, thus poisoning them.

The Apple Leaf-crumpler.

MINEOLA INDIGINELLA (*Zell.*)

Order, *Lepidoptera;* Family, *Phycitidæ.*

DESCRIPTION.—*Larva.*—The larva, when full grown, is a caterpillar about two-thirds of an inch long, with sixteen feet, and cylindrical in form, tapering gradually from first to last joint. It has a dull green-colored body, but a brown head.

Imago.—The perfect insect is a small gray moth, "slightly varied with brown. The wings are narrow and applied to the body when at rest, and across the end of them are three oblique blackish lines, the terminal one consisting of a series of black points. Antennæ setaceous and simple; labial palpi long and recurved; maxillary palpi short and distinct."

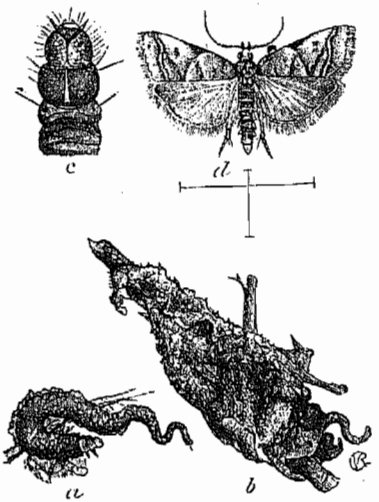

FIG. 5. MINEOLA INDIGINELLA (*Zell.*) The Apple Leaf-crumpler.—*a*, case in which the caterpillar lives, with the fore part of its body protruding from the opening in the large end; *b*, several cases fastened together; *c*, the head and fore part of the caterpillar's body, enlarged; *d*, imago.

Life-history.—During the winter months, there may be found upon the twigs of the various orchard trees, masses of dry leaves, which are the dwelling-places of the larvæ of the leaf-crumpler. From these curious abodes, in which the larvæ also pupate, emerge small grayish moths, that deposit eggs upon the leaves of the trees, which the larvæ use for food plants.

During the fore part of June, small brownish worms appear, which at once construct tubular silken cases, in which they conceal themselves when not eating. It is mostly during the night that the larvæ leave these cases for the purpose of feeding. As they grow, they draw about them many partially-eaten leaves, so that when winter approaches each case is almost hidden.

Upon the approach of cold weather, the cases are fastened to the twigs by silken threads. To insure a secure fastening for winter quarters, the larvæ gnaw away the bark, so that they may obtain a firm hold.

As the leaves begin to appear in spring, the larvæ reveal themselves, and at once feed upon the tender leaves, and often eating out the flower buds. They continue to grow until some time in May, when they close the opening to their cases and pupate. In two weeks the moth emerges, thus completing its life-history.

Work.—When in sufficient numbers, they can seriously check the development of the tree, and as they often feed upon the buds, they can greatly diminish its vitality.

Other Food-plants.—The leaf-crumpler, besides feeding upon the apple, feeds upon the quince, and on both wild and cultivated varieties of cherry, plum and crab-apple, and possibly upon the peach.

Natural Enemies.—There are known two parasites which prey upon this apple pest, viz., Tachina phycitæ *LeB*, and Limneria fugitiva *Say*.

Remedies.—The cheapest and at the same time the most effectual method of destroying this enemy is to collect the larval cases during the winter, as they are quite conspicuous, and destroy them by burning. It has also been recommended to collect them in a pail and place them in some part of a field away from the orchard, so that in spring the worms will soon die from want of food, while the parasites as above mentioned will mature and fly away. For young trees infested, spraying with arsenites is recommended.

Apple-tree Tent Caterpillar.

CLISIOCAMPA AMERICANA *Harr.*

Order, *Lepidoptera;* Family, *Bombycidæ.*

DESCRIPTION.—*Larva.*—The full grown larva, which measures nearly two inches in length, is "hairy and black, with a white stripe down the back, and on each side of this central stripe there are a number of short, irregular, longitudinal yellow lines. On the sides are paler lines, with spots and streaks of pale blue. The under side of the body is nearly black."

Imago.—The perfect insect is "a dull yellowish-brown or reddish-brown moth, characterized chiefly by the front wings being divided into three nearly equal parts by two transverse whitish, or pale yellowish lines, and by the middle space between these lines being paler than the rest of the wing in the males, though it is more often of same color, or even darker in females." The species is very variable.

In addition to what has been said, the male may be known by its conspicuously feathered antennæ, while those of the female are rather inconspicuous.

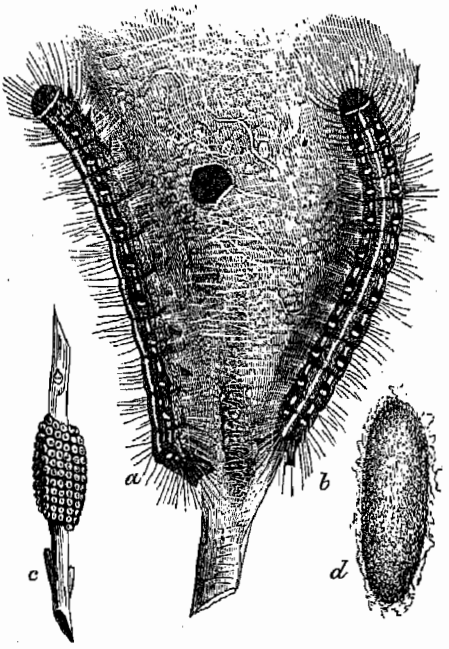

Fig 6. CLISIOCAMPA AMERICANA *Harr.* Apple-tree Tent Caterpillar.—*a*, side view; *b*, back view of larva, as seen on the outside of the web or tent; *c*, batch of eggs on a twig; *d*, cocoon.

Life-history.—The appearance of this pest is always announced in early spring by the small, bright and glistening webs, which are invariably found in a neglected apple orchard. The eggs are deposited in batches upon small twigs, and when the larvæ are hatched all that come from the same batch of eggs work in harmony in constructing the tent, which they use for shelter when not feeding and during inclement weather.

Fig. 7. Imago.

They have regular periods for feeding, once in forenoon and once in afternoon, not appearing in the morning earlier than 9 o'clock. They feed upon the leaves for five or six weeks, during which period they moult or change their skins four times. At the end of this time, they scatter in many directions in search of some sheltered spot, in which they can spin their cocoons. They soon pupate, and remain in this quiescent state for three weeks.

The cocoon is an oblong-oval yellow case, composed of silk, mixed with a yellow paste, which when dry looks something like sulphur.

The moth lives only long enough to deposit her eggs. She places them around small branches, and covers them with some glutinous matter, which when dried protects them from rain and

the severity of the weather. Each cluster contains two to three hundred eggs.

Work.—In the five or six weeks during which the larvæ feed, the inhabitants of a very few tents can defoliate a tree. The tents are always constructed in forks of the branches, giving the trees a very ugly appearance, and their presence only shows the negligence of the owner of the orchard.

Natural Enemies.—Very often the chrysalids of these caterpillars are filled with small maggots, which produce minute metallic green and black colored flies, belonging to the same genus as the celebrated Hessian-fly.

Other Food-plants—The caterpillars of this moth feed upon the plum, thorn, rose, besides the cherry and apple, both cultivated and wild. It has also been found upon the willow, poplar and white oak.

Remedies.—This insect can be easily exterminated by picking off and destroying, during the winter, the eggs which were so conspicuously placed on the branches by the moth in May. Should any of the egg-clusters escape notice during the winter, you can easily destroy the larvæ in early spring, by burning. This can be done by using a torch, which can be readily made by saturating a piece of cloth with kerosene and tying it to a stick. For the purpose of killing them by burning, the tree should be visited early in the morning or late in the afternoon, while they are housed within their tents.

As the insect prefers the wild black cherry, it has been suggested by Dr. Fitch that a few of these trees be planted in the vicinity of the orchard, as it would be far easier to destroy the larvæ or eggs on these few trees, than on a hundred or more that may be in the orchard.

The Tussuck Moth.

ORGYIA LEUCOSTIGMA (*Abb.–Sm.*)

Order, *Lepidoptera;* Family, *Liparidæ.*

DESCRIPTION.—*Larva.*—The larva is a hairy caterpillar, measuring from one inch to one inch and a half in length. The color is "cream yellow, with a black dorsal stripe extending the whole length posterior of the third segment; next to the dorsal stripe is a yellowish line, then a greenish blue stripe on which is sometimes a black line; stigmatical line black, and below this is a yellow

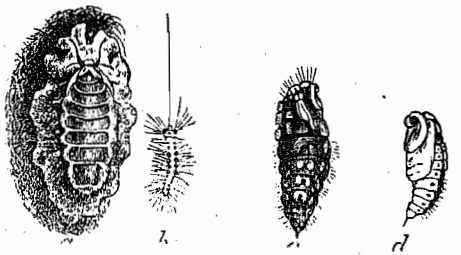

Fig. 8. ORGYIA LEUCOSTIGMA (*Abb.-Sm.*)—The Tussuck Moth.—*a*, the female moth on her cocoon; *b*, a young larva; *c*, the female pupa; *d*, the male pupa.

line; ventral parts yellowish-white, tinged with blue. On the dorsal part of segments 4, 5, 6, and 7, there are tufts of whitish hairs, and from the anterior part of the body, two long black pencils of hair project forward, while from the dorsal part of the eleventh segment projects backward and upward another black pencil. On the dorsal part of the ninth and tenth segments are two small red warts; head reddish-brown or dark red."

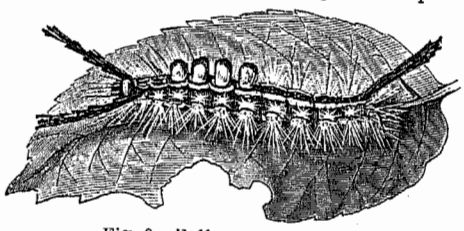

Fig. 9. Full-grown larva.

Imago.—The male insect is an ashen-gray colored moth with an expanse of wing one inch. The fore wings are crossed by wavy bands of dark color, and on each wing there is a small white crescent near the inner angle. Antennæ pectinate.

Fig. 10. Imago. (Male.)

The female is a wingless, oval, brownish moth, measuring about a half inch in length. Antennæ small.

Life-history.—On the dead leaves of the apple, which very often remain attached to the branches of the tree during the winter months, may be found empty cocoons, on the underside of which there can be usually found a mass of eggs.

As soon as the leaves begin to unfurl in spring, young "worms' are hatched from the eggs. They immediately feast upon the tender leaves, and continue to devour them for nearly two months, at the end of which time they enclose themselves within a cocoon, from which they soon emerge as moths.

To escape danger, the larvæ have a peculiar habit of lowering themselves by means of a silken thread, which they climb when danger has passed.

The female moth is very sluggish, on account of the mass of eggs which she carries, and having no wings, she awaits her mate, resting upon the empty cocoon, to which she finally attaches her eggs. The male, possessing wings, soon finds her, and after pairing, the eggs are deposited about three or four hundred in a mass.

The eggs of the first brood soon hatch, and the caterpillars complete their growth by early autumn, and enter the pupal state. The moth, which soon emerges, deposits her eggs, and these remain unhatched until the next spring.

Work.—The larvæ are voracious eaters, and are classed as among the most destructive leaf-eating caterpillars. It does much damage to our shade, as well as our fruit trees.

Other Food-plants.—The larvæ of this species, though partial to the apple, feed upon the plum, pear, cherry, rose, occasionally on elm, maple, horse-chestnut, linden, oak, locust, butter-nut, black walnut, hickory, spruce, fir, larch and other plants.

Natural Enemies.—There are known to be seven parasites that serve to keep in check the increase of this insect.

Remedies.—As already noted, the young larvæ lower themselves from the branches upon slightly jarring the tree, and it is by this peculiar habit that many can be killed. The surest method of preventing their ravages is to destroy the egg-masses in the winter, when they are so easily discovered. Such arsenites as Paris green or London purple may be used very effectively in poisoning the larvæ.

The Yellow-necked Caterpillar.

DATANA MINISTRA *Drury.*

Order, *Lepidoptera;* Family, *Notodontidæ.*

DESCRIPTION.—*Larva*—The larva is a black or reddish-brown caterpillar nearly two inches long, and usually marked with four yellow lines on each side of the body. The body is covered, though scatteringly, with long, whitish woolly hairs. The head is black, with the first segment posterior to it of a bright wax-yellow color.

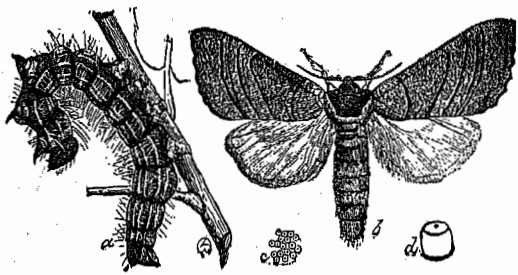

Fig 11. DATANA MINISTRA *Drury.* The Yellow-necked Caterpillar.—*a*, larva; *b*, imago; *c*, eggs; *d*, an egg enlarged.

Imago.—The adult insect is a reddish-brown moth with an expanse of wing nearly two inches. The fore wings are marked with several transverse darker brown lines; the hind wings are of a pale yellowish color and unmarked.

Life-history.—The insect never makes it appearance before midsummer. The white and spherical eggs are deposited side by side in patches from seventy to a hundred. They are always placed on the under side of the terminal leaves, so as to give the young worms the tenderest of the foliage to feed upon; but as they increase in size, they eat not only the parenchyma, but devour the entire leaf, leaving only the mid-rib.

Unlike Clisiocampa americana *Harr.*, they do not spin a tent, but like them, they are strictly gregarious. No visible web is to be seen, yet they feed in dense clusters, leaving only the mid-rib of each leaf as they go.

They possess two characteristic habits, viz., that of elevating their heads and tails at right angles with the rest of the body, and that of congregating at the moulting periods, which is noticeable even to the most careless observer. For the purpose of moulting they come down on the side of the trunk, or attach themselves on the under side of one of the large branches, forming a dense mass, which position they maintain by means of shreds of web, extending over and through them. Here they remain for two or three days until moulting is accomplished, when they again ascend the tree and continue their work of defoliation.

Like other social caterpillars, they begin to scatter towards the end of their larval career, and in about six weeks they descend to the ground and burrow into the soil to the depth of three or four inches, where they remain, in the pupal stage, during the winter and spring months. When the moths begin to emerge, they continue to do so for several weeks, which is evidently due to the different periods of time at which the larvæ enter the pupal state; for it is known that some continue to feed upon the foliage until frost renders it unfit for their nutriment.

Work.—They cannot be regarded as a very dangerous pest, for, on account of their gregarious habits, they may be kept under control, but when unmolested, only a short time is needed by them to defoliate a tree.

Other Food-plants.—Besides the apple, they feed upon the leaves of the cherry, quince, oak, hickory, black walnut, black locust, birch, basswood, thorn, hazel and sumach.

Natural Enemies.—They are kept in check by a species of ichneumon fly, Ophion mundum *Say*, and devoured in large quantities by the American cuckoo, (Rain-crow.)

Remedies.—The twigs upon which the larvæ are feeding may be cut off and burned, but should they become too numerous, they can be easily destroyed by spraying the infested parts with Paris green in a water mixture.

The Spring Canker Worm.

PALEACRITA VERNATA (*Peck.*)

Order, *Lepidoptera;* Family, *Geometridæ.*

DESCRIPTION.—*Larva.*—The full grown worm, which scarcely measures an inch in length, is provided with ten legs. It is commonly ash-gray on the back, darker at the sides, and yellowish beneath. In the intensity of its markings it varies very much.

Imago.—The ash-gray female has no wings, but the body is more or less marked with black along the back, the thorax with a black spot, and the legs alternately marked with black and white.

The front wings of the male are pale ash-gray, crossed by three equi-distant jagged, more or less defined black lines, all curved inwardly, and most distinct on the front or costal border; and by a somewhat broader whitish line, which runs from the posterior angle to apex, inner and terminal borders also being marked with black. The hind wings are silvery gray, and the under surfaces are of the same uniform silvery gray color, each wing with a discal spot, the front wings each with an additional spot on costa.

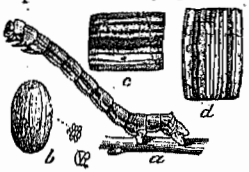

Fig. 12. PALEACRITA VERNATA (*Peck.*) The Spring Canker Worm.—*a*, larva; *b*, an egg, enlarged, with a small cluster of the natural size to the right; *c*, side view; *d*, back view of one segment of the larva's body, enlarged.

Life-history.—The eggs, which are elliptic ovoid in form, are deposited on the small branches in batches of sixty to a hundred or more. They stand side by side, and are glued together and to the bark by a grayish varnish, which is secreted by a gland in the end of the body.

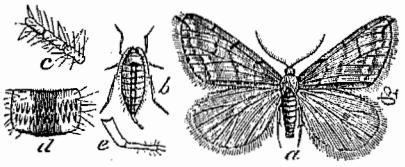

Fig. 13. *a*, the male moth; *b*, the female moth; *c*, three joints of her antennæ, enlarged; *d*, one or her abdominal segments, enlarged; *e*, her ovipositor, enlarged.

From these eggs are hatched looping caterpillars, or "measuring worms," that feed upon the parenchyma of the leaf. Their halting or looping gait is caused by the few legs which they possess. As the buds of the apple open, a few little dark worms, about the size of horse hairs, can be found nibbling on the exposed edges of the opening leaf.

Having obtained its growth in from four to five weeks, it ceases eating, and either crawls down the trunk or drops to the ground from the branches by means of the silken cord which it spins from a little opening in its under lip. After deserting the tree, it does not wander about, but immediately burrows into the ground to the depth of two to six inches, where it spins a silken cocoon. In twenty-four hours after this cocoon is made, it changes its form to that of a pupa, in which condition it remains until awakened by the warmth of early spring.

On the advent of spring, the moths leave their earthy abode and seek the sunshine. The female, possessing no wings, crawls up the trunk of the tree and there awaits her mate. He soon finds her, and after pairing, the eggs are deposited and the life-history of the insect is repeated.

Work.—They sometimes appear in such large numbers in May as to give the orchard a scorched appearance, as if struck by fire. When they complete their work, the trees are destitute of everything that is green, and from the branches hang rusty and sere looking leaves, which flutter feebly in the breeze. Fortunately

the loss of leaves does not always kill the tree, but it prevents the growth of the fruit.

Other Food-plants.—This insect also attacks the elm, cherry, plum, besides various other fruit and shade trees.

Natural Enemies.—This pest is preyed upon by many predacious insects and insectivorous birds. There is a beautiful ground beetle known as Calosoma scrutator *Fabr.*, that ascends the trunk of the tree and devours the caterpillars. A tachina fly and an ichneumon fly are also very effective in destroying these devastators of the foliage. To this list may be added twenty-five or more small birds which use them for food, the commoner of which are the robin, cat-bird, chipping-sparrow, red-wing black-bird and Baltimore oriole.

Remedies.—Although aided in such an efficient manner by nature, we are forced to seek other protection from this pest, so as to increase the abundance of apples. As the females have no wings, they are forced to climb the tree to deposit their eggs. To prevent the ascent of the females, a band of stiff paper covered with tar, which may be kept soft by castor oil, can be tied near the base of the tree. Bank the loose dirt around the tree as high as the band so as to prevent laying of eggs below the band.

For entrapping the female moths, strips of cotton batting two or three inches wide tied about the middle with a small cord will also be found very effective.

Should this be neglected until after the eggs are hatched, spray trees with Paris green or London purple—a pound to 200 gallons of water. This spraying has good results, if applied while the larvæ are quite small.

The Fall Canker Worm.

ANISOPTERYX POMETARIA *Harr.*

Order, *Lepidoptera;* Family, *Geometridæ.*

DESCRIPTION.—*Larva.*—The larva is a pale olive-green caterpillar when young, but when grown, varies in color from greenish yellow to dark brown It is one inch in length, and is provided with twelve legs. It is marked with a broad brownish dorsal band, with three white lateral lines on each side, the middle one paler, and below the spiracles there is a broad band, and then a broad white band. The under or ventral parts are flesh color, while the head is brown.

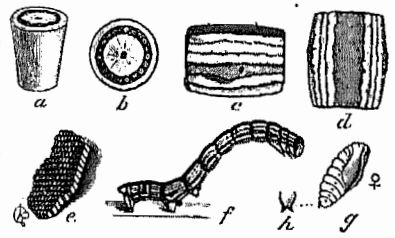

Fig. 14. ANISOPTERYX POMETARIA *Harr.* The Fall Canker Worm.—*a*, side view of one of the eggs, enlarged; *b*, view of upper end of same, enlarged; *c*, side view of a segment of larva's body, enlarged; *d* back view of same, enlarged; *e*, cluster of eggs; *f*, larva; *g*, female pupa; *h*, tips of same, enlarged.

Imago.—The male is provided

with wings; "the fore wings, brownish gray, glossy, crossed by two whitish irregular bands, the outer one enlarging into a large pale spot at the apex. Hind wings grayish brown with a white band across them, and in center a faint blackish dot."

Fig. 15. *a*, the male moth; *b*, the female moth; *c*, several joints of her antennæ, enlarged; *d*, a segment of her body, enlarged.

The female is wingless, with a "uniform shining ash color above, gray beneath; length three to four-tenths of an inch." She is very sluggish in her movements, and has a spider-like appearance.

Life-history.—The eggs, which are deposited side by side in regular rows, from seventy-five to two hundred in a cluster, hatch about the time the buds of the apple tree begin to expand. The young larvæ at once feed upon the tender leaves, which are spread out so invitingly before them. The expanding flowers or buds serve to shelter them during wet or cold weather.

When young they only eat holes in the leaves, but when older, they devour the entire pulp of the leaf, leaving only veins and mid-rib. These caterpillars can be easily recognized by the alternate looping and extension of the body while in motion, and it is by this that they came to be commonly known as "inch, or measuring worms."

While not feeding they often rest upon the last two pairs of prop-legs, and when in this position, it is hard to distinguish them from the twigs. They feed about four weeks, when they leave their lofty habitation and crawl down the trunk, or drop to the ground by means of silken threads, and enter the ground to the depth of from two to six inches.

Here they form a tough cocoon of colored silk interwoven with earth, in which they turn into the chrysalis, remaining in this dormant condition until autumn or winter, when they appear as moths, thus completing their life-history.

Work.—When the "canker worms" are plentiful, they can, in the four weeks that they feed, destroy the foliage of the infested tree, giving it the appearance of being scorched by fire.

Other Food-plants.—The fall canker worm is found upon the apple and other fruit trees, but it has a preference for the elm.

Natural Enemies.—They are preyed upon by ichneumon flies, a wasp, a tachina fly, and several predaceous beetles, not to say anything of various birds that devour them.

Remedies.—As the eggs are often deposited in exposed places on the trunks of trees, they can easily be collected in late winter or early spring and destroyed.

Early fall plowing is recommended so as to expose the cocoons

to the weather and the birds. Such a method used for their destruction proves very effectual.

Measures that may be used to prevent the female moth of the spring canker worm from ascending the tree may also be used advantageously against the fall canker worm moth, as the female is also wingless.

OTHER INSECTS INJURING THE LEAVES.

The Apple-tree Aphis, APHIS MALI *Fabr.*; the Apple Leaf Aphis, APHIS MALIFOLIA *Fitch*; the Fall Web Worm, HYPHANTRIA TEXTOR *Harr*; the Greater Leaf-roller, LOXOTÆNIA ROSACEANA *Harr.*; and the Bud Worm, PENTHINA OCULANA *Harr.*

INSECTS INJURING THE FRUIT.

The Codlin Moth, or Apple Moth.

CARPOCAPSA POMONELLA (*Linn.*)

Order, *Lepidoptera;* Family, *Grapholithidæ.*

DESCRIPTION.—*Larva.*—The larva or "worm" is white, with a black head and collar, and a black spot on the top of the last segment. On each segment there are eight black dots so grouped as to make four rows, extending the entire length of the body. As the larva increases in size, the black parts become brown, the dots pale or grayish, and often indistinct, while the body assumes a more or less pinkish tint. The full grown larva measures nearly three-fourths of an inch.

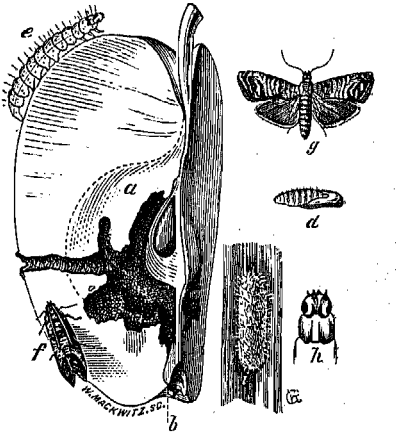

Fig. 16. CARPOCAPSA POMONELLA (*Linn.*) The Codlin Moth, or Apple Moth.—*a*, an infested apple; *b*, the place where larva entered the same; *d*, pupa; *e*, larva; *f*, and *g*, imagos; *h*, head and fore part of the larva's body—back view enlarged; *i*, cocoon.

Imago.—The perfect insect is a moth with the fore wings crossed by numerous gray and brown lines, in the hind angle of which is a large oval, dark brown spot, with edges of a bright copper color. The head and thorax are brown mingled with gray, while the abdomen and hind wings are light yellowish brown. It has expanse of wing three quarters of an inch.

Life-history.—In early spring, the female moth deposits its eggs singly in the calyx end of the young apple before the stem of the apple has been turned down. In a week after the deposition of the egg, the larva appears, but so small as scarcely to be seen by the unaided eye. It at once begins to eat its way into the apple

towards the core. Having arrived at the core, the worm subsists mainly upon the seeds, which seem to be very agreeable to its taste.

At this stage it is not quite half grown, and only a short time passes before it begins to make a passage to the side of the apple through which its castings can be pushed to the exterior, and it is through this opening that it finally makes its exit. Its full growth is obtained in three or four weeks, during which time it reaches the core, burrowing through the apple in several directions, but only making one opening to the exterior besides the one by which it entered.

Having finished its larval growth, it leaves the apple and searches for a protected place in which to pupate. It often leaves the apple before the apple falls, and to be able to do this nature has given it a spinneret, which is an opening in the lower lip, through which a small flow of viscal fluid can issue; when this fluid comes in contact with the air it hardens, and by a silken thread formed in this way, the larva lowers itself to the ground or to the branches below, where it can find a hiding-place.

When it drops to the ground with the apple, it leaves the apple almost at once, and creeps into the chinks in the bark of the tree, or to some other sheltered place, where it spins a cocoon, from which it emerges a moth in two weeks.

The life of the adult insect is quite brief, not exceeding more than a week. This short period is occupied in pairing and depositing the eggs. These eggs produce the autumnal brood, which are so damaging to our ripening apples.

The most curious circumstance in the life-history of this insect is that it passes its winter in the larval stage, enclosed in a cocoon, but does not change to pupa till within a week or so of the time when it comes forth as a moth in spring. It is this moth that lays the egg from which hatch the larvæ that injure the growing fruit.

There is no insect more injurious to the apple than this one. It is not confined to America only, but is also an inhabitant of the British Isles and Europe, where it has long been known and studied.

Work.—The wormy apples in our cellar and the sudden fall of apples on a still night in early spring can be attributed to the work of this insect. The presence of the larva may be known by the excrement at the burrow, which it makes in entering the apple. It makes a passage to the core, where it feeds for a time upon the seed, and then upon the pulp of the apple, until it obtains its full growth, when it escapes from the apple.

The falling of the apple is known to be hastened by the injury

received within, which generally causes premature ripening. When the moths first appear, the apple, on account of its size, is incapable of supporting more than one worm. The egg is always deposited in the calyx end of the fruit so as to ensure its attachment to the tree until the larva has matured. When the second brood appears, the apple is much larger and can support more than one worm, so that in the late summer, two worms are often found in an apple; but it is known that the same moth never lays but one egg on the same apple. The two worms in the same apple are invariably of different sizes, which shows quite conclusively that they are the offspring of different parents.

Other Food-plants.—The Codlin Moth is also injurious to the peach, apricot, pear and quince.

Natural Enemies.—By inhabiting the substance of the fruit they escape many kinds of insectiverous birds; the only time that they ever expose themselves is the brief period after leaving the apple, when they seek for a covert in which to spin their cocoons. There are reasons to believe that they take advantage of darkness for this descent, but even then they cannot escape the penetrating beak of the woodpecker, whose instinct enables him to discover and destroy them in their winter quarters.

There are two species of ichneumon flies that are known to attack the larvæ of the Codlin Moth, but as they have very few opportunities to sting the enclosed larvæ, they can aid but very little in reducing the number.

There are also white, oblong and somewhat depressed coleopterous larvæ, that feed upon the Codlin Moth in its earlier stages. They are the larvæ of small, oblong and somewhat flattened beetles, belonging to the genus Trogosita.

Remedies.—Every moth deposits fifty or more eggs, and as each worm can ruin an apple, we can see the importance of destroying the insects in their winter quarters. Those of the second brood, which pass the winter in the larval stage, seek for the deepest protection they can find. Being thus imbedded into the substance of the wood or bark, we can only look to the wood pecker for aid in destroying them.

We can prevent them from burying themselves so deep by wrapping the trunk and large branches of the trees with bands of cloth, which will offer them a sure protection from the cold weather. For these bands, it is best to use strips of old carpets six inches wide and long enough to wrap twice around the tree. They can be kept in place by a piece of twine tied around the middle of the band. It is best to use two bands—one about a foot from the ground, so as to entrap those that fall with the apple, and one where the large branches join the trunk, so as to entrap those that leave the apple before it falls.

As the moth first makes its appearance early in May, the bands should be examined not later than the middle of April, and all the larvæ found upon them picked off and destroyed.

To prevent an increased number in the next brood, it will be safe to say that within six weeks after the falling of the blossoms, the bands should be examined and all the larvæ found be destroyed.

As the infested apple can be easily detected by the rust-colored mass of castings at the end of the calyx, another practical method for destroying the larvæ would be to pick the wormy apples from the trees, and give them to the swine, or destroy them in some other way.

To prevent the moth from depositing eggs, spray with one pound of London purple mixed with 250 gallons of water, just at the time of the first falling of the blossoms. For fear that the eggs have been deposited before the first application of this arsenite, repeat the spraying within ten days, which will poison the newly-hatched larvæ as they attempt to penetrate the forming fruit.

The Apple Curculio.

ANTHONOMUS QUADRIGIBBUS *Say.*

Order, *Coleoptera;* Family, *Curculionidæ.*

DESCRIPTION.—*Larva.*—The larva is a small, soft white grub about .45 inch long, when full grown, and has its body scatteringly covered with soft hairs. It has an arched and wrinkled body, but with a free and almost perpendicular head. On each thoracic joint may be found a pair of ventral tubercles, each bearing a distinct bristle. The head is yellowish brown, while the body is bluish black on dorsal vascular line and in space between wrinkles.

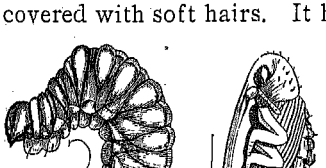

FIG. 17. ANTHONOMUS QUADRIGIBBUS *Say.* The Apple Curculio.—*a*, pupa; *b*, larva, both enlarged.

Imago.—The beetle is about the size of the Plum Curculio, one-sixth of an inch long, but can be easily distinguished from it by the following characters. It is broader behind than at the shoulders, where it is furnished with four conspicuous humps. The snout, which is about as long as the body, extends out almost horizontally, and cannot be folded under as in the Plum Curculio. The body is brown, with the thorax and one-third of wing covers ash gray. The color is quite uniform, and the thorax has three or more distinct pale lines.

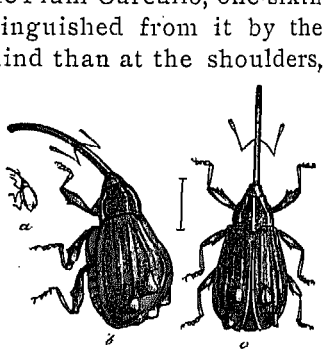

FIG 18. *a*, Imago, natural size; *b*, Imago, side view, enlarged; *c*, Imago, back view, enlarged.

Life-history.—For the reception of the eggs, the female drills holes in the fruit by means of her snout. By both sexes, holes one-tenth of an inch deep are made in the apple for food, but when the female wishes to deposit her eggs, she scoops out the bottom in the shape of a gourd, and there places a nearly oval and yellowish egg about .04 of an inch long. Only a short time after the deposition of the egg, it is found to be larger than the puncture at the orifice, indicating that it has swelled from absorption of nutritive fluids from the surrounding fruit, as is the case with eggs of many saw flies and other snout beetles.

By the first of June the larvæ are hatched, and they at once penetrate to the center of the fruit. Here they remain until full-grown, which requires nearly a month.

The fully developed larva differs so remarkably from that of the Plum Curculio as to be easily distinguished by its softer and much whiter covering, but principally by its arch-back and much-folded body.

From the hour of its birth until the hour when it emerges as a perfect insect, the apple is its home. When its larval growth has been completed, it forms a neat cavity and throws off its skin, assuming the pupal stage. It remains in this inactive state for a period of two or three weeks, before coming forth as a "snouted" beetle.

It is single-brooded and winters as an adult beetle. The larvæ generally begin their work by the first of June, although they may be found in the fruit, in one stage or the other, through the months of June, July and the greater part of August.

Work.—Punctures of the beetles produce hard and rounded, though sometimes irregular, knots and swellings, which dwarf and deform the fruit. Aside from these injuries, the punctures offer a good place for the development of fungus-spores, for, being necessarily moist, they catch and hold the spores that are supposed to be floating through the atmosphere. It is generally conceded that the Plum and Apple Curculio are the principal agents in promoting the rot of the apples, plums, peaches, etc., for it has been noticed that the rot spreads in a circle from these punctures.

Other Food-plants.—Before apples received such extensive cultivation, these beetles were bred in wild crabs and haws, but now they infest the apples, pears and peaches.

Natural Enemies.—As it is cradled within the fruit from its birth to the perfect insect form, it is little exposed to the attacks of parasites. It may have a few insect enemies, but the writer does not know them.

Remedies.—As a preventive against feeding and egg-depositing,

the fruit may be sprayed with the arsenites, as for the Codlin Moth, with very favorable results.

Should the fruit become infested before spraying, it can be jarred down, as it does not fall as when affected by the Codlin Moth, and when collected can be destroyed by feeding them to hogs, or by some other practical way.

OTHER INSECTS INJURING THE FRUIT.

The Apple Maggot, TRYPETA POMONELLA *Walsh;* and the Plum Curculio, CONOTRACHELUS NENUPHAR *Herbst.*

NOTICE.

As to the nomenclature, the writer has been unable, for the want of sufficient literature, to make use of the parentheses in cases where they might be needed, and for this reason, a list of the species, where the parentheses have been properly used, is appended:

CHRYSOBOTHRIS FEMORATA (*Fabr.*)
PALEACRITA VERNATA (*Peck.*)
ORGYIA LEUCOSTIGMA (*Abb.-Sm.*)
MINEOLA INDIGINELLA (*Zell.*)
CARPOCAPSA POMONELLA (*Linn.*)

APPENDIX.

Spraying Machinery.

Insecticides and fungicides, either liquid or in fine powder, can be used to best effect and with economy only by using properly constructed spraying pumps. These are now made in great variety, and are found on sale in any city or large town, so that one can obtain, at moderate cost, such apparatus as is best adapted to the work to be done.

They are made in all shapes and sizes, so as to be suited for the garden and the vineyard as well as for the orchard.

The essential points of a good machine are that it be durable, work easily, and throw a forcible and constant stream; that the nozzle be so constructed as to throw a spray which can be easily regulated at the will of the operator. Those machines are best in

which the pump and nozzle are made of brass; because acid solutions quickly corrode iron parts. Whatever be the material or

construction of the machine, it can be kept in order, and its usefulness prolonged, only by thoroughly cleaning after using, a precaution which should never be neglected.

Where one has but a few trees to be cared for, a hand pump, varying in cost from $2.50 to $9, can be used advantageously, and will be in readiness to apply insecticides to garden fruits and vegetables.

The illustration represents such a force pump as can be used for all ordinary work in the orchard. It can be attached to a barrel or tank, carried on wheels or in a wagon, so as to be movable; or the suction hose can be dropped into a stationary tank. Such a pump, with twenty feet of hose and a nozzle so adjustable as to throw a coarse or fine spray, can be obtained for about $15. By using a longer hose, the nozzle can be tied to a light pole, and from the ground or from a short ladder all the foliage and fruit can be reached by the spray.

Some provision must be made for the constant stirring of the mixture or solution in the tank or other containing vessel. This is necessary in all cases, and especially so with the mixed poisons.

It is very important that suitable nozzles are used in spraying, for the secret of good work does not lie in the pump alone. As no nozzle has been made which is suitable for all kinds of work, it is well to have several, differently constructed. As one of the best, may be mentioned the Vermorel; the Cyclone, Climax, Gem and Boss are much used, and appear to give satisfaction.

In spraying with preparations that kill by contact, the aim should be to distribute them so as to reach as many insects as possible. Great care should be used with arsenites, that the mixtures are not so strong as to "scorch or burn" the foliage. To avoid such injury, these poisonous mixtures should be very dilute aad applied evenly; and as a further precaution, it is best to use them on a cloudy day or late in the afternoon, thus avoiding the hot sunshine.

INSECTICIDES.

Paris Green.—This poison is a chemical combination of arsenic and copper, called arsenite of copper. Practically, it is insoluble in water, containing from fifty-five to sixty per cent. of arsenic. For spraying orchard fruit, it is used in the proportion of one ounce to twelve gallons of water. It can be bought from the druggist at thirty cents per pound.

London Purple.—This insecticide is a by-product in the manufacture of aniline dyes. In water, it remains in suspension much longer than Paris green, as it is a finer powder, and for this reason it is more liable to injure the foliage when applied too heavily. It contains about the same per cent. of arsenic, but is cheaper, retailing at fifteen cents a pound.

Hellebore.—This is a vegetable poison and is made from the roots of White Hellebore. It is less dangerous than the mineral arsenical poisons, and kills both by contact and by being eaten. When prepared for use, mix one ounce to three gallons of water, or a pound to a barrel.

Pyrethrum.—This insecticide is made from powdered flowers of certain plants of the genus Pyrethrum. It is used either as a dry powder or in water (one ounce to three gallons); but is also used as a fume, or a decoction, or an alcoholic extract, diluted. When used as a dry powder, it is best to dilute with six or eight parts of flour. It is excellent for killing common cabbage worms. Three principal brands are upon the market, known as Persian Insect Powder, Dalmatian Insect Powder, and Buhach. It is very difficult to obtain the pure, fresh article, for when exposed to the air the poisonous principle volatilizes, and the powder is worthless.

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